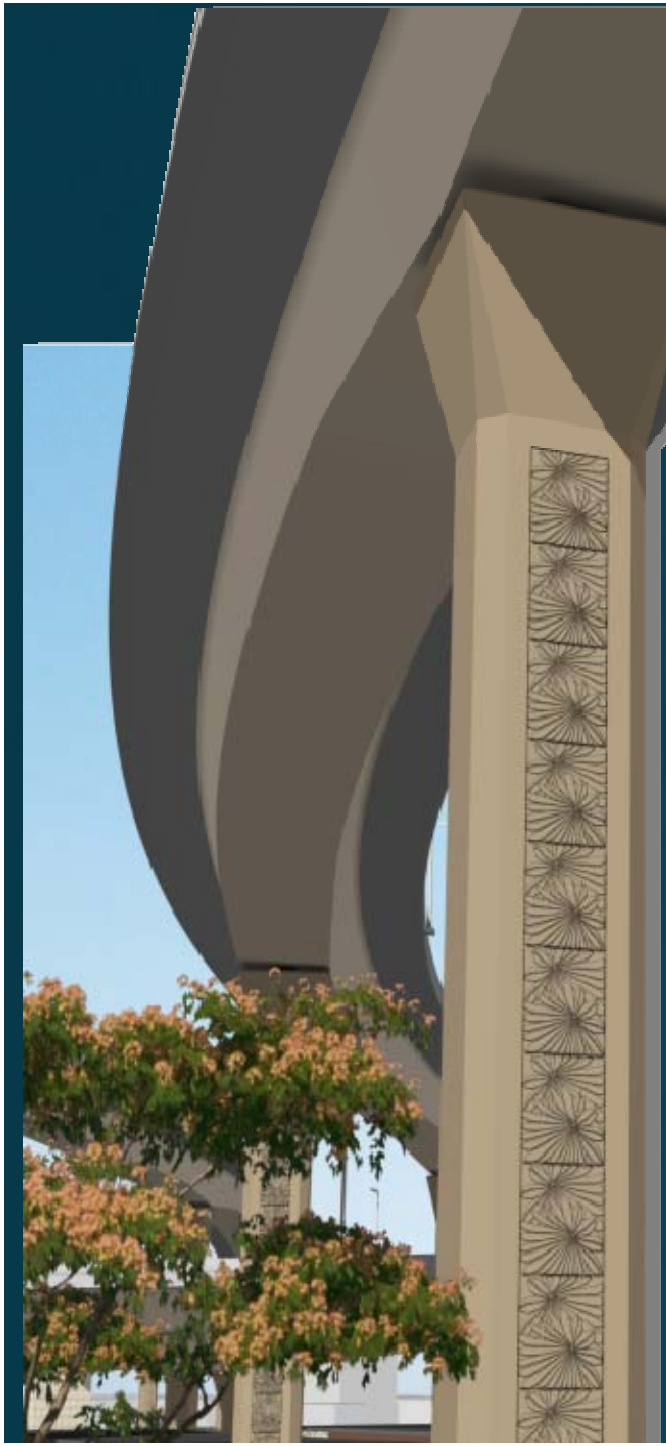


Palmetto Section 5
SR 826/836 Interchange
Miami, Florida
"Bridge Design and Construction"

Jerry M. Pfuntner, P.E.
Principal and
Assistant Technical Director
Finley Engineering Group, Inc.

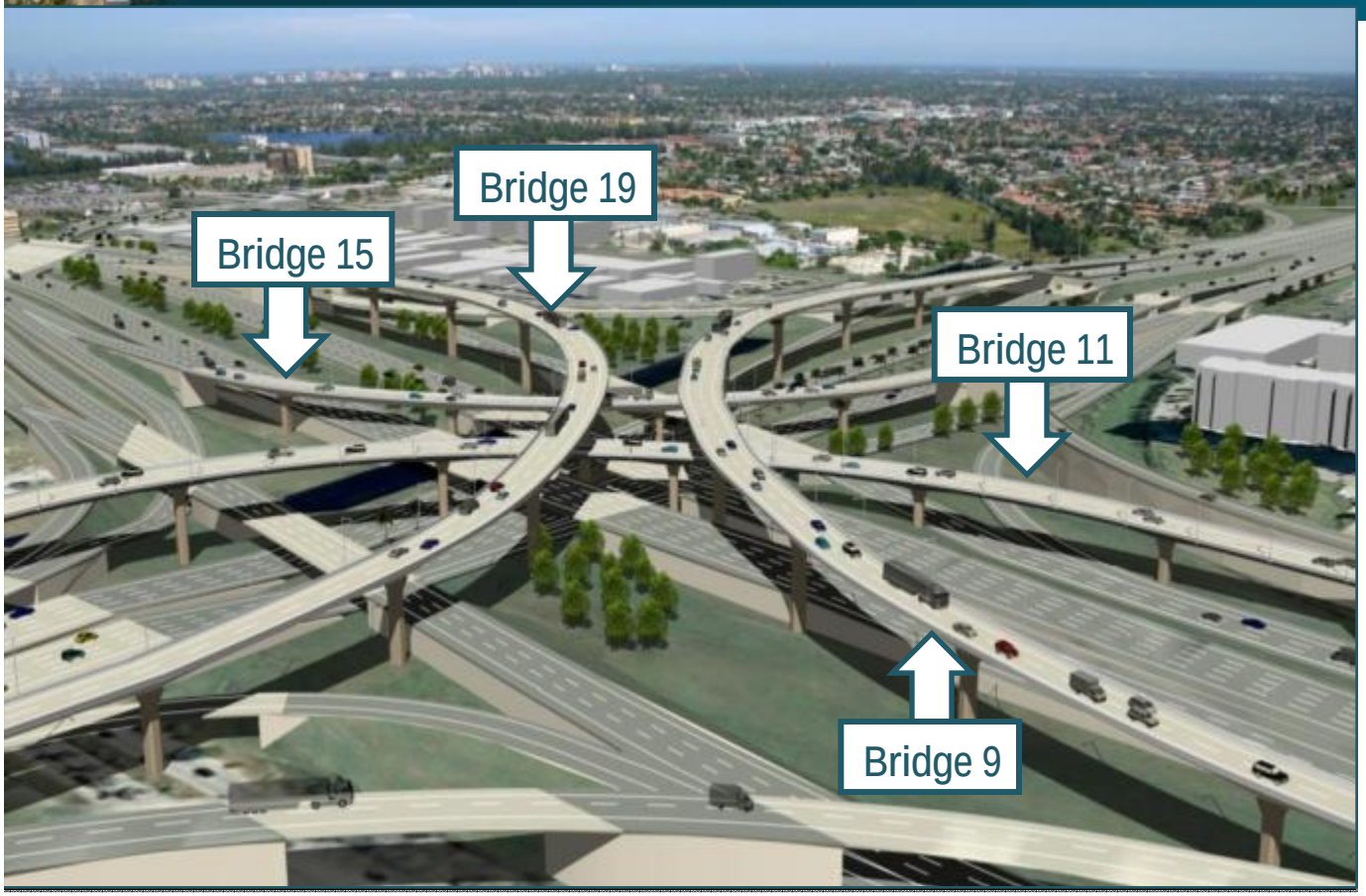
Western Bridge Engineers' Seminar
Wednesday, September 28, 2011 - 8:30am – 10:00am

Agenda

- Project Overview
- Pre-Bid Challenges
- Segmental Superstructure Design
- Special Details
- Construction Engineering
- Q & A

Project Overview – Existing Interchange

Overview of the Four Segmental Bridges



Project Details:

- 360,718 square feet of deck area
- 7,763 linear feet of bridge
- Longest span 266’ and tallest pier 81 feet
- Number of segments 775

- **Bridge 9** – 2,310 feet long, 46 feet wide
- **Bridge 11** – 1,785 feet long, 46 feet wide
- **Bridge 15** – 1,100 feet long, 46 feet wide
- **Bridge 19** – 2,540 feet long, 46 feet wide

Pre-Bid Challenges

- Foundations
- Core of Interchange/MOT
- Erection Methods/Access
- Florida DOT Structures Guidelines
- Roadway Geometry

Pre-Bid Solutions

- 24” Precast Concrete Piles
- Build Superstructure from Top:
  - No temporary supports on the ground
  - Use a launching gantry
  - Segments – 80^{T}
  - Stabilize off pier caps

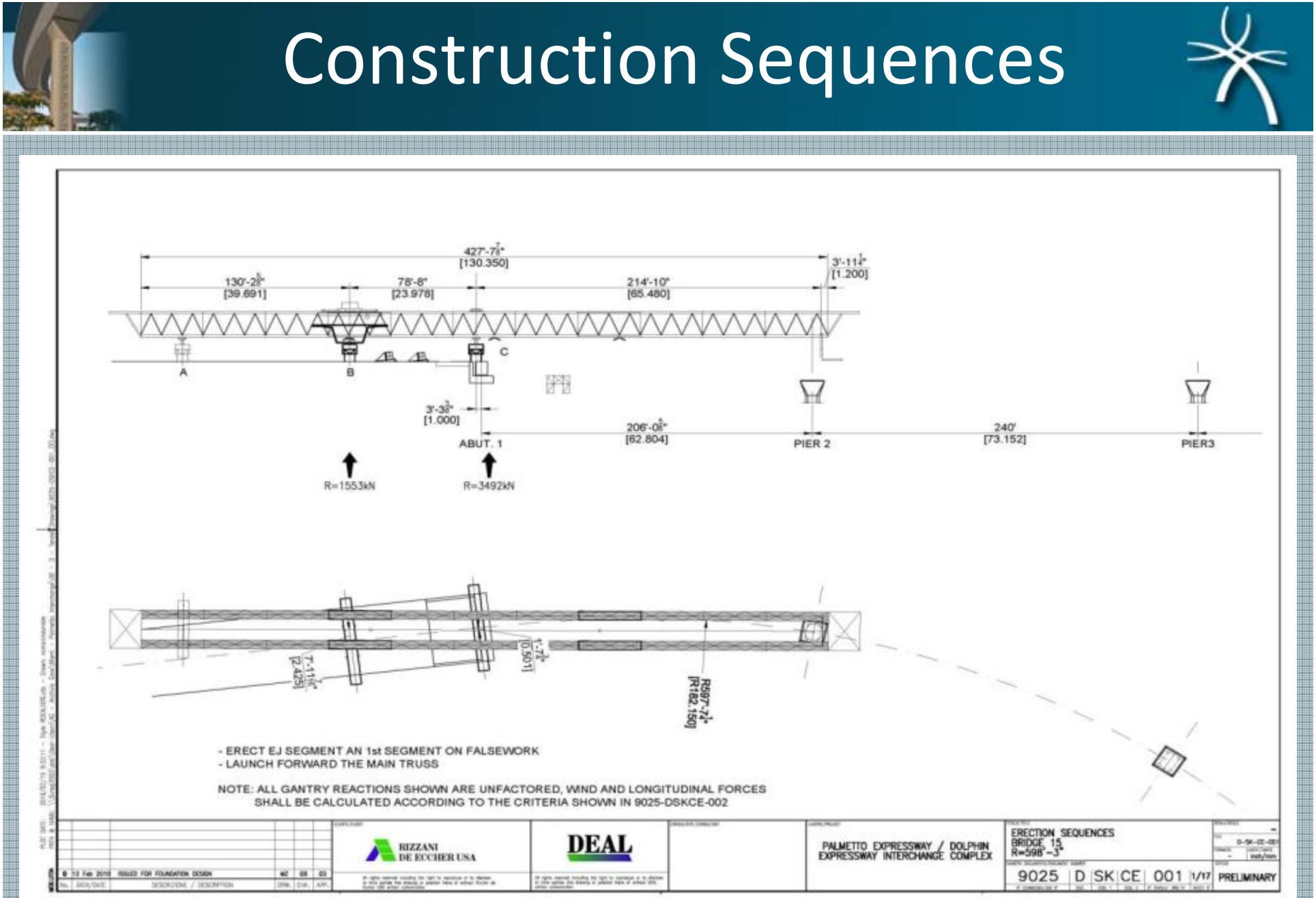
Pre-Bid Solutions *Continued*

- Alternate Technical Concepts:
  - Mid-span expansion joints
  - Diabolos/External PT
  - Diaphragms and anchor blocks
  - Stay-in-place polystyrene forms
  - Variable depth segments

Segmental Superstructure Bridge Design

- Overview Four Segmental Bridges
- Special Considerations
- Design Approach
- Special Details
- Construction Engineering

Construction Sequences



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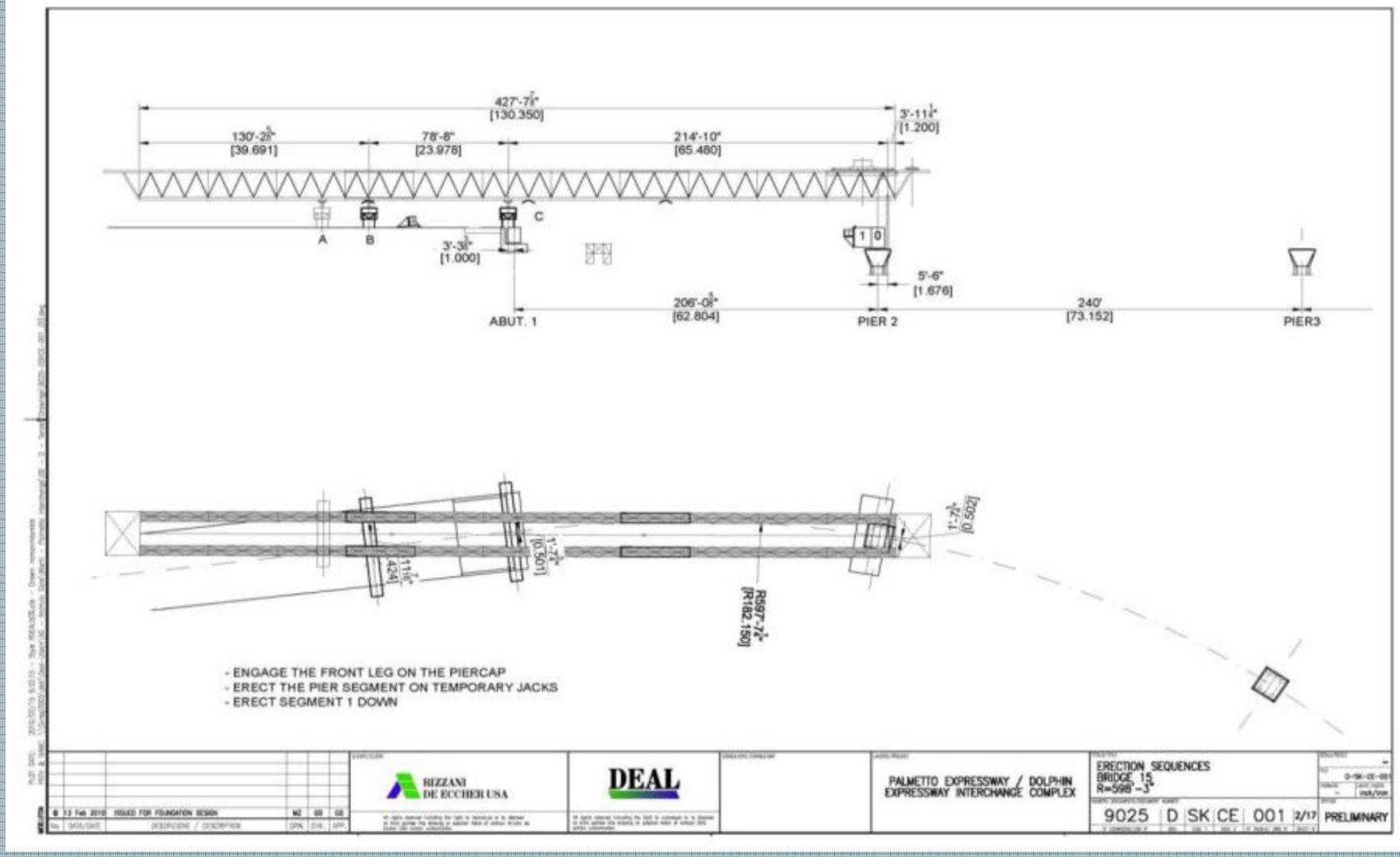
Construction Sequences



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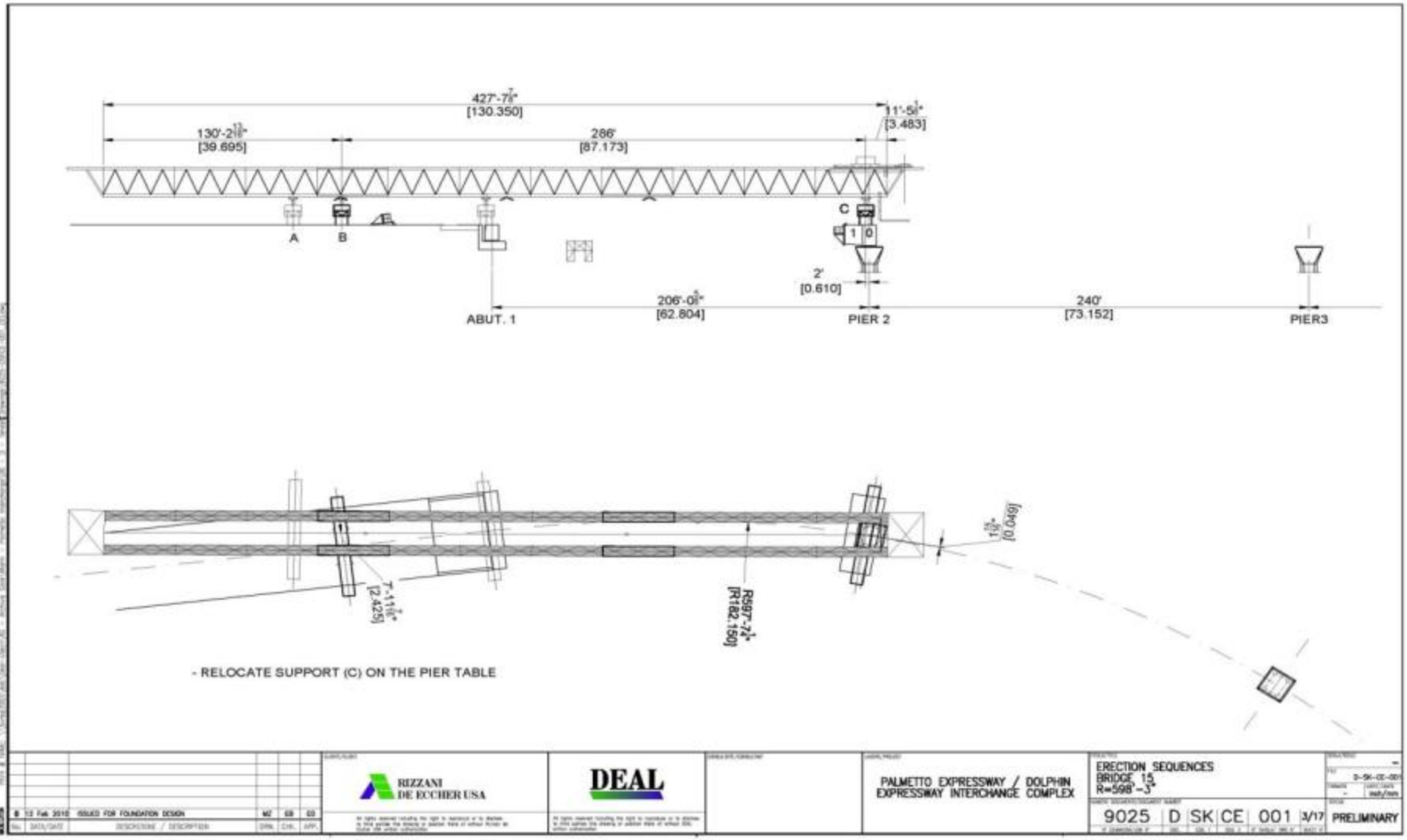
Construction Sequences



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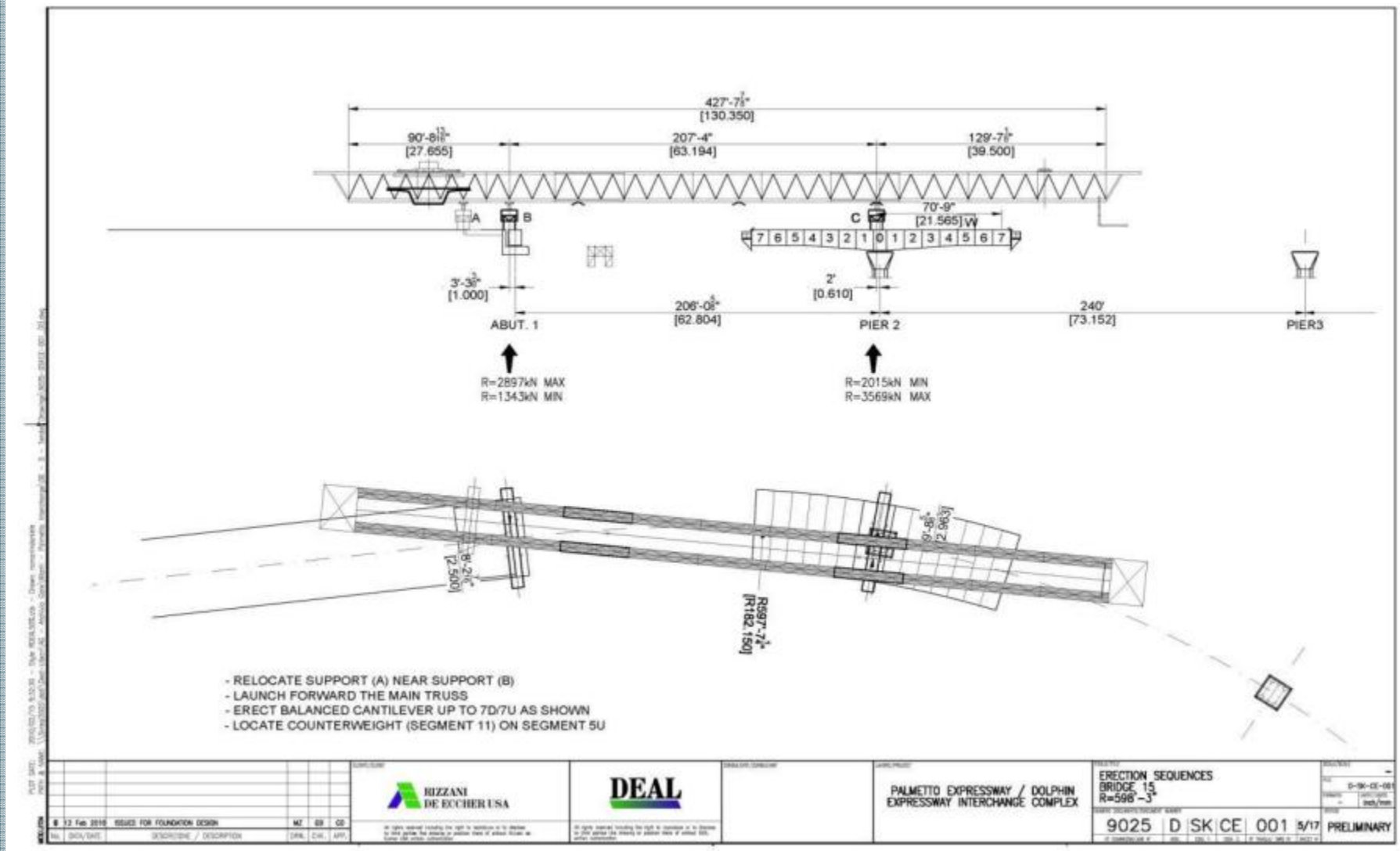
Construction Sequences



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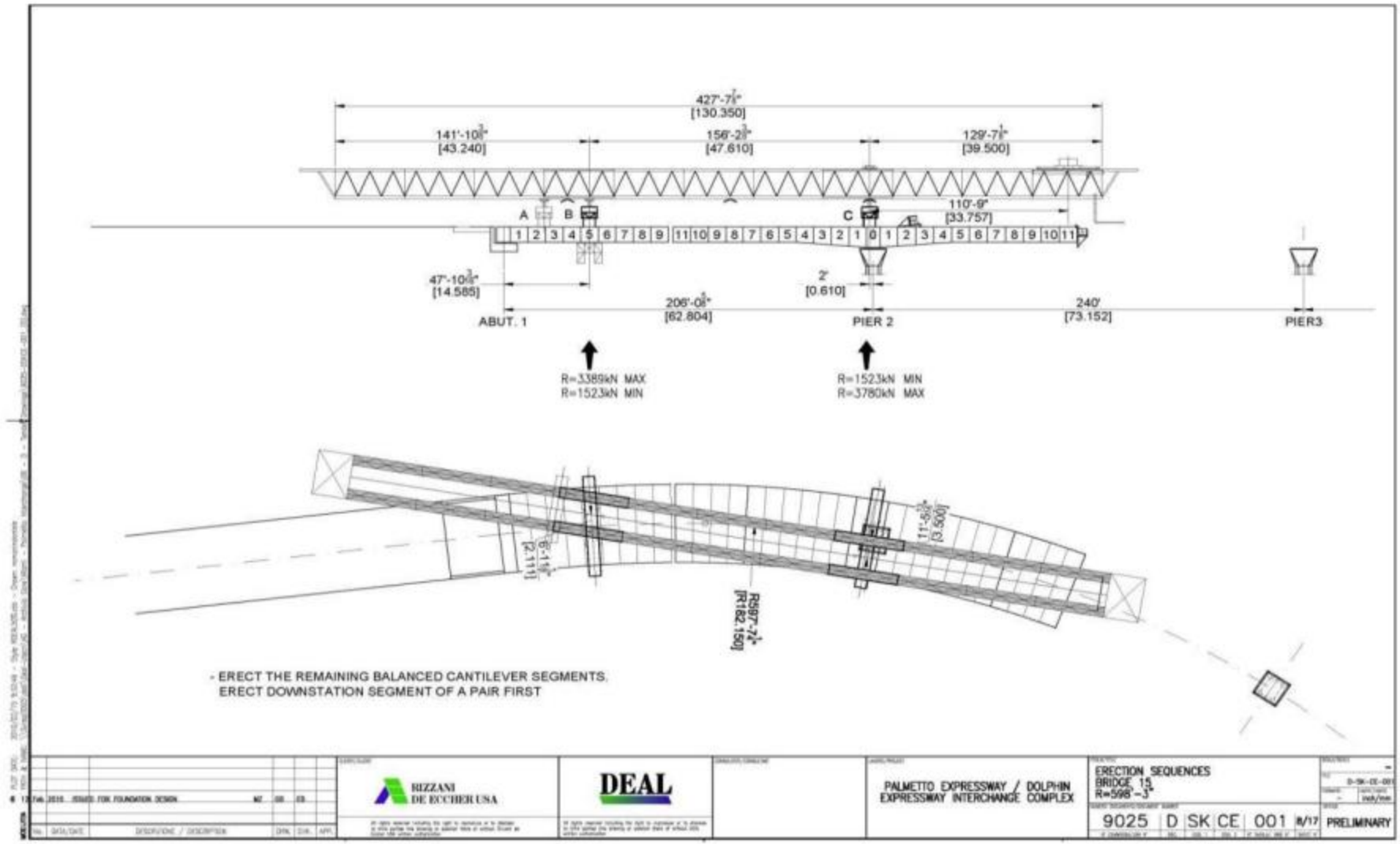
Construction Sequences



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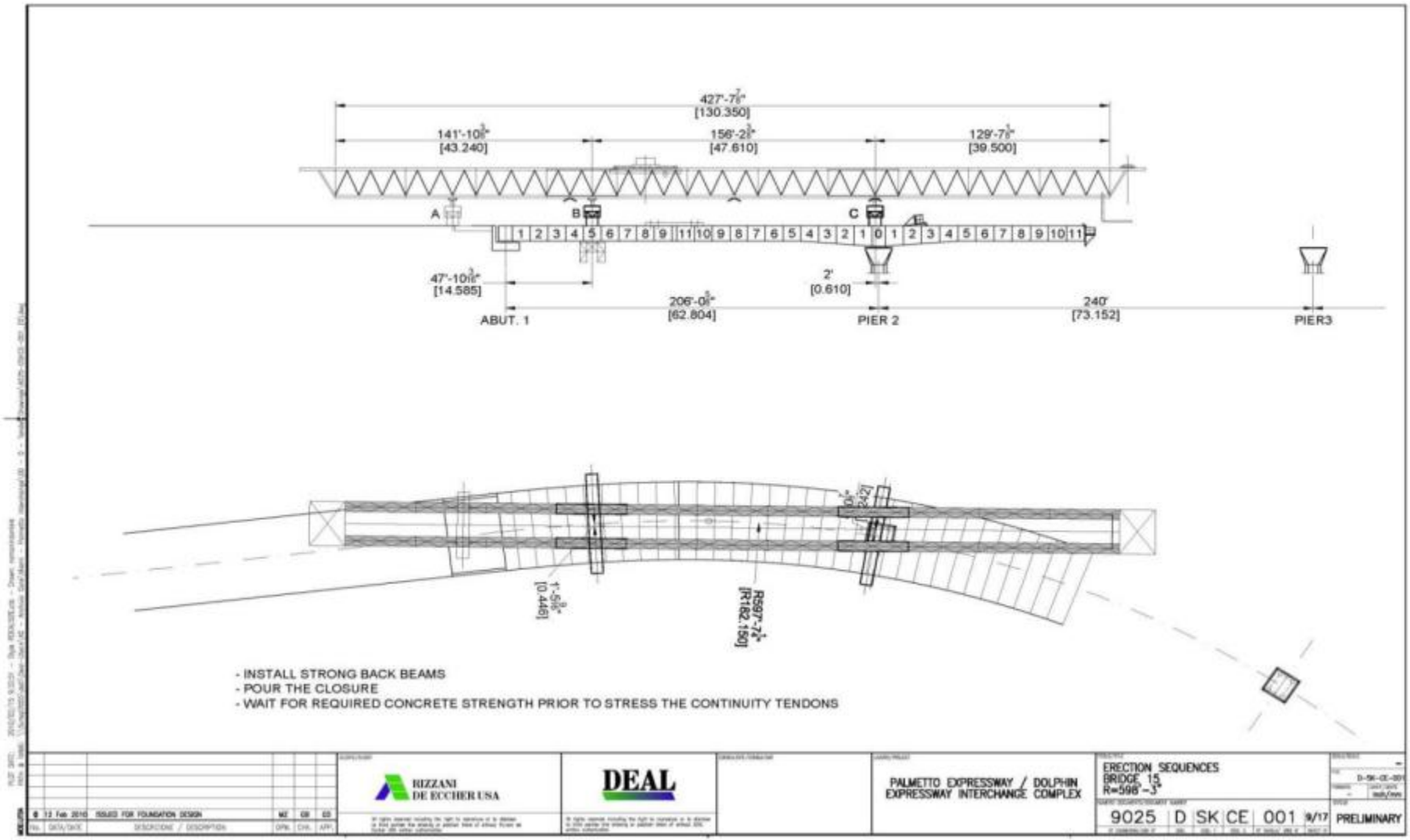
Construction Sequences



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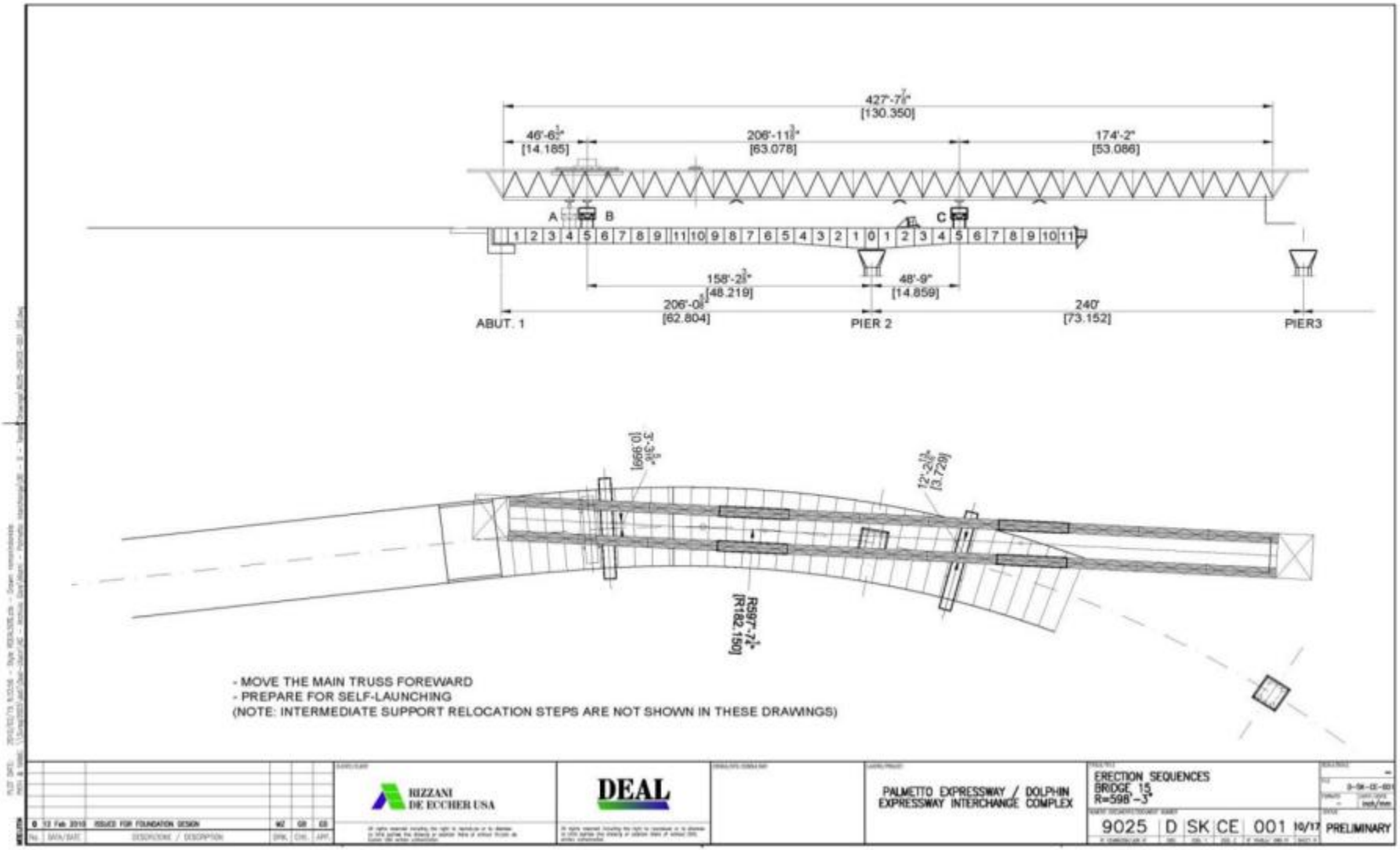
Construction Sequences



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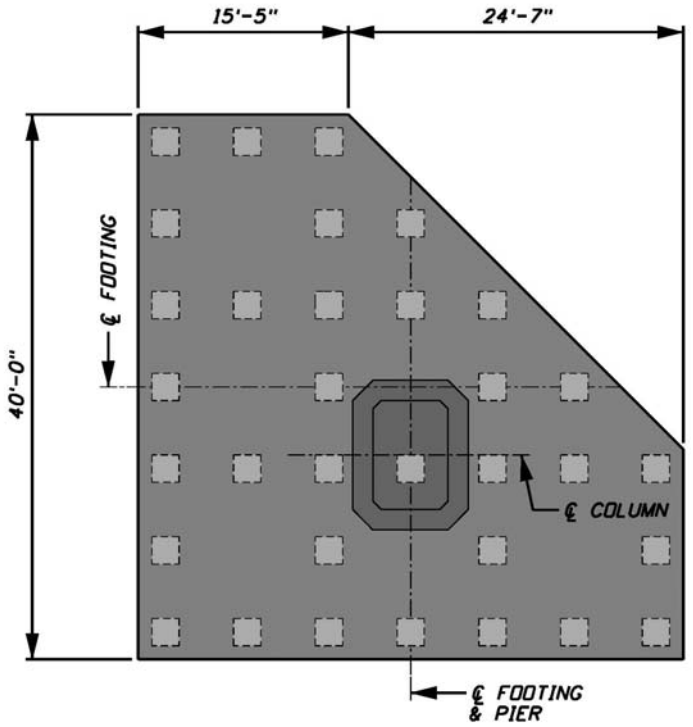
Superstructure

- Variable depth segments 12’ to 9’
- Weight restrictions – 80^{T}
- Height restrictions – 16’6”
- External post-tensioning
- Anchorage/Diaphragm Design

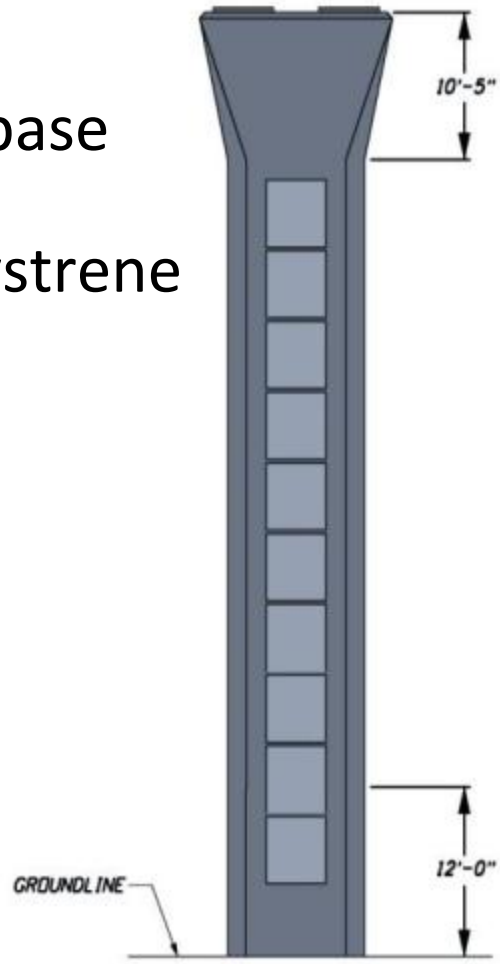
Special Considerations

- Substructure and Foundations:
  - 24” Piles - 250 tons (C) & 25 tons (T)
  - Irregular Footing Shapes
  - Footing Depth – Shear Reinforcing
- MOT/Staging Considerations

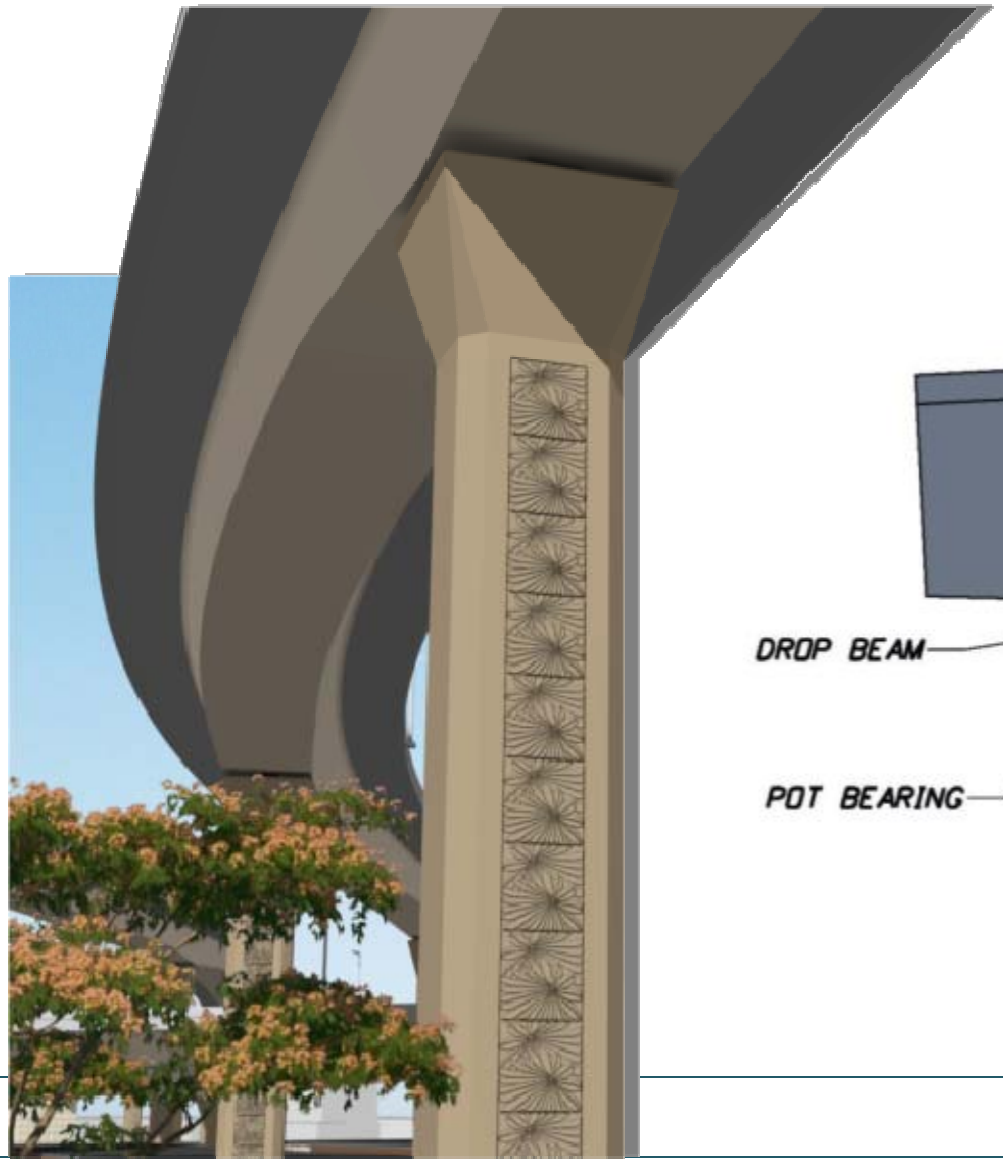


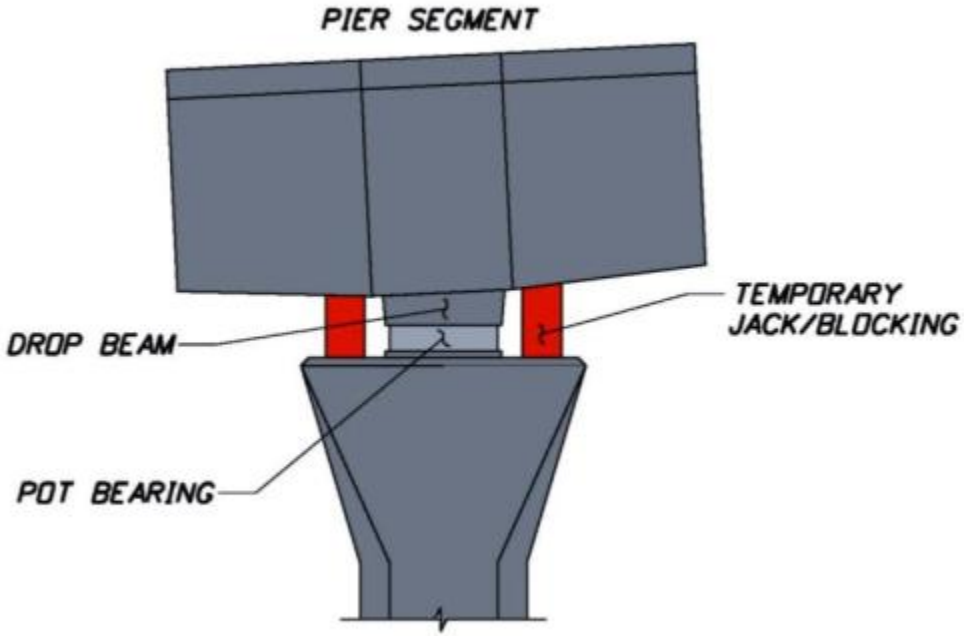
Special Considerations – Columns and Caps

- Columns and Caps:
  - Columns solid at the base
  - Box Column with Polystrene
  - Solid Cap



Special Considerations –Cap Details



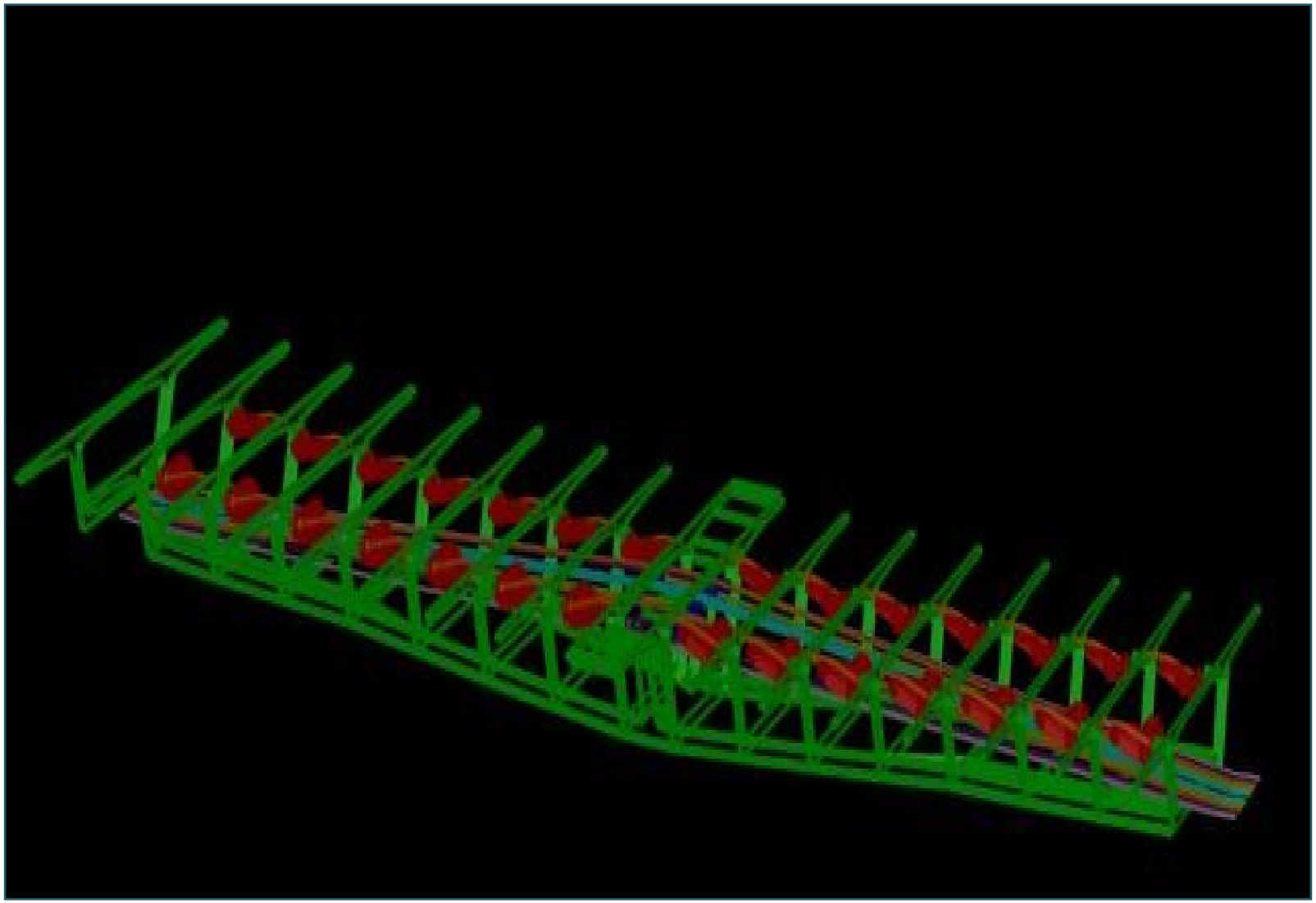


Cap was Key

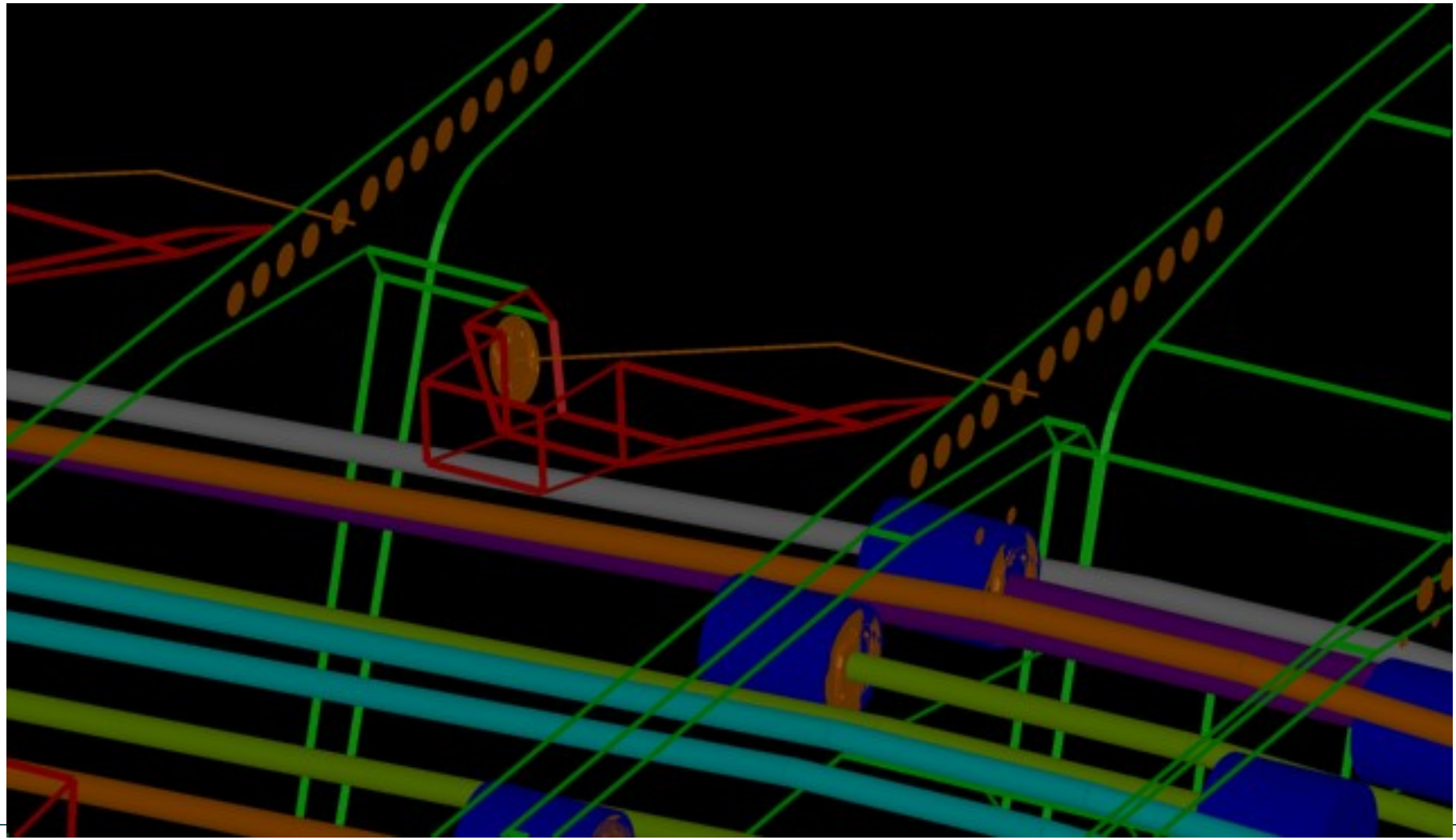
Design Approach

- BrIM Approach from the beginning
- All analysis – 3D and RM
- All drawings – MicroStation RMv8i and Rebar
- Construction sequencing and equipment

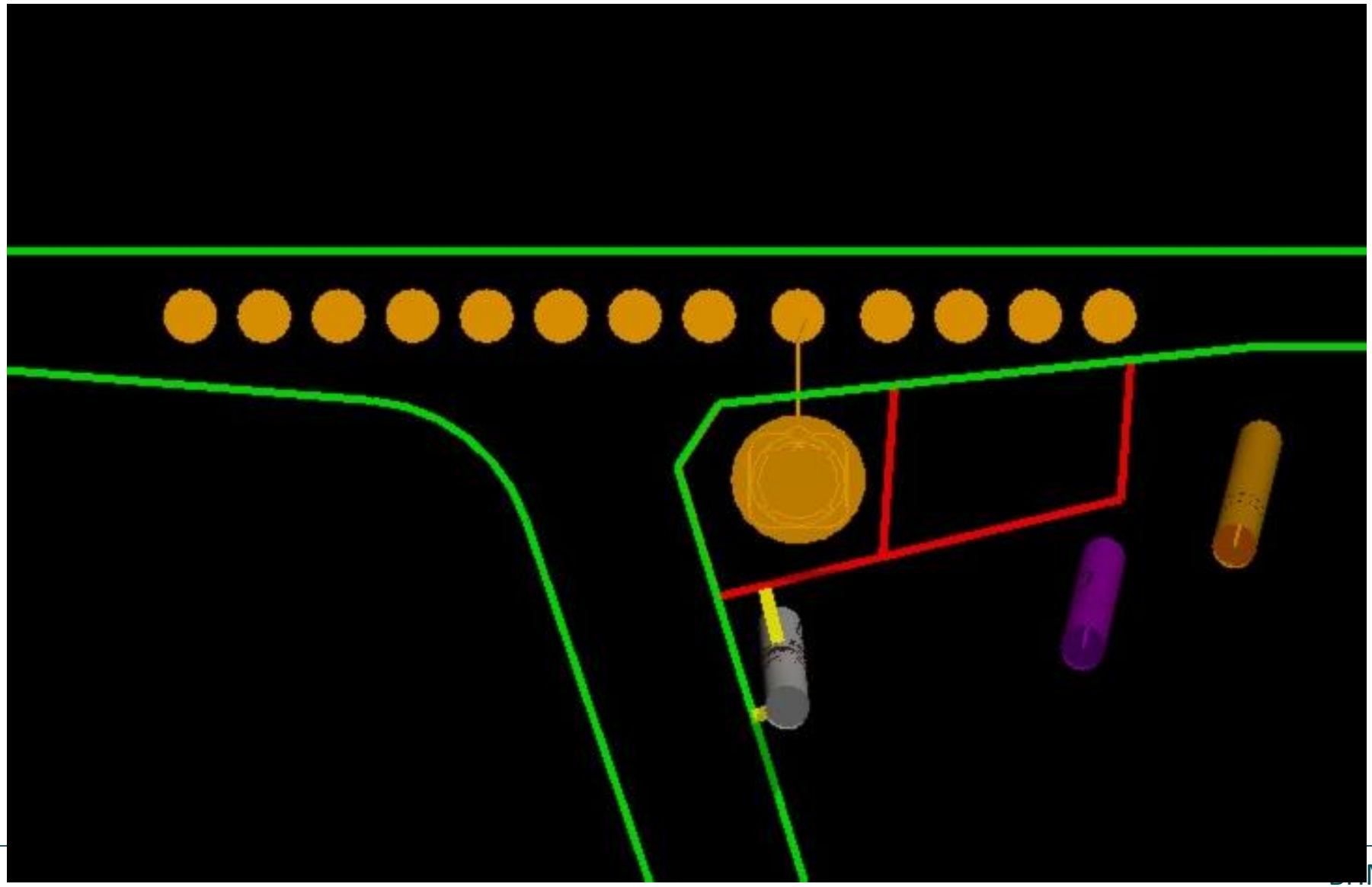
BrIM Modelling



Tendon Blister Clearance



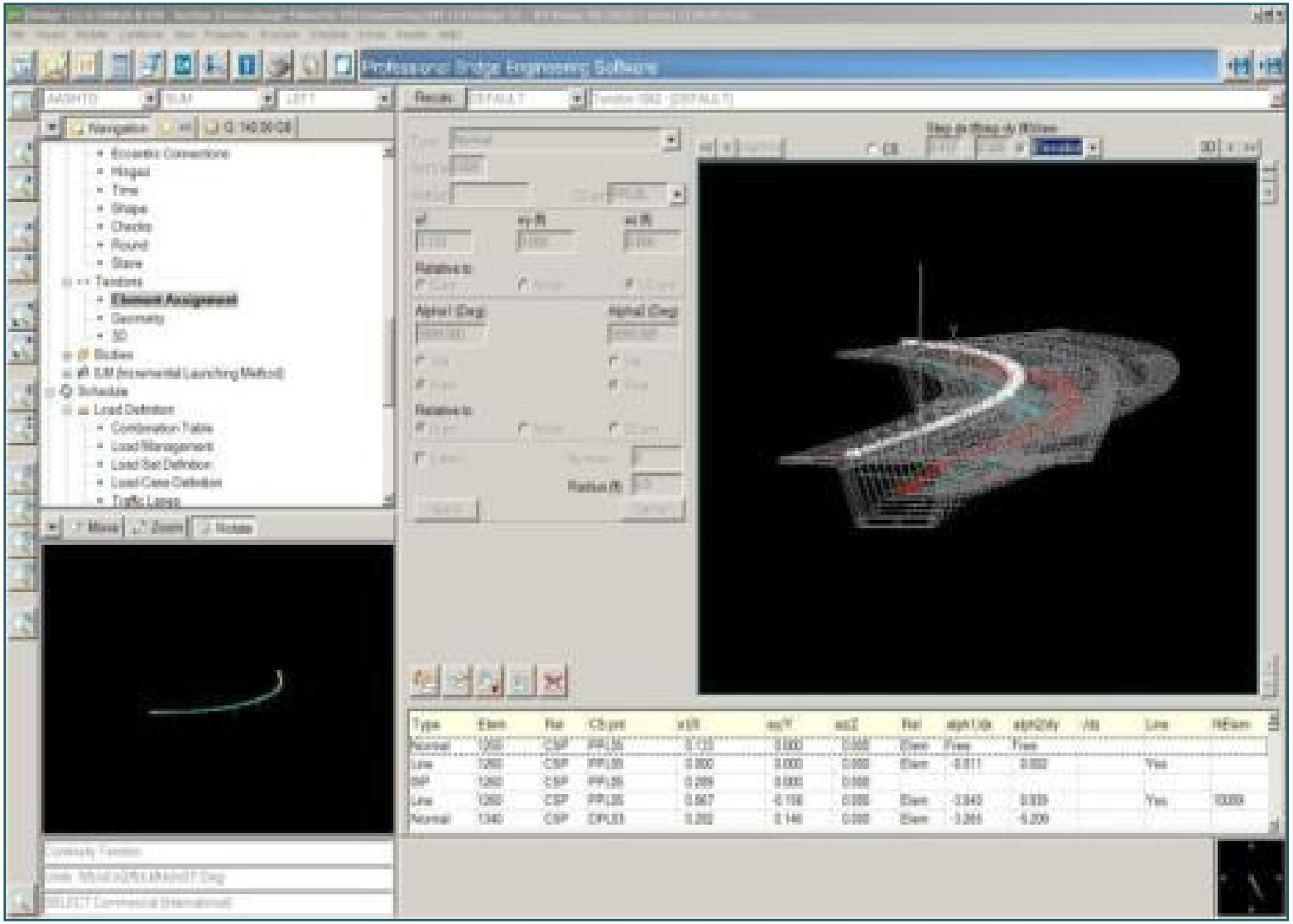
External Tendon Clearance to Web



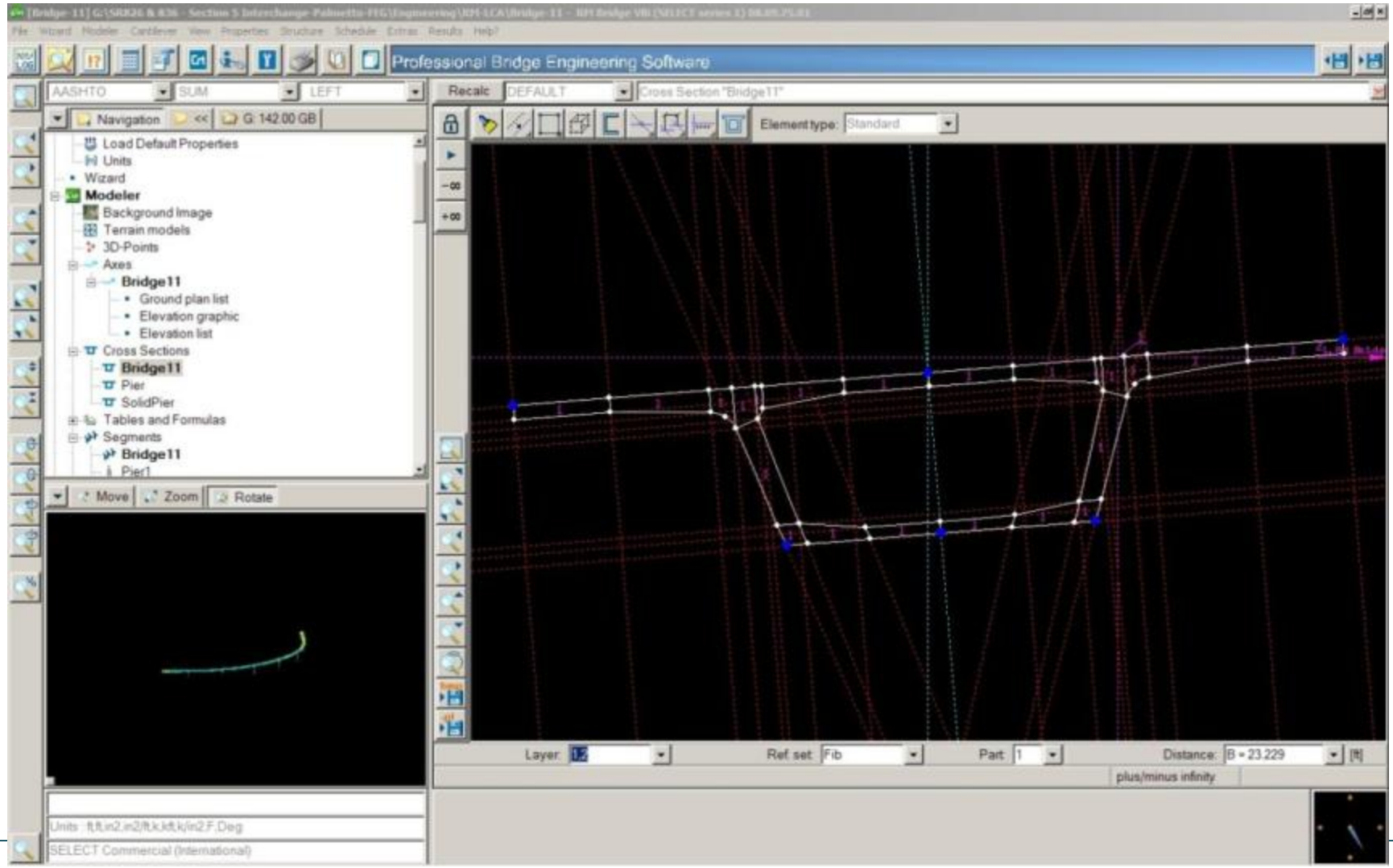
Design Approach

- Critical to the design of segmental structures
- Model needs to incorporate:
  - Changing boundary conditions
  - Phased addition of elements
  - Changes in statical scheme
  - Locked–in forces due to erection loads

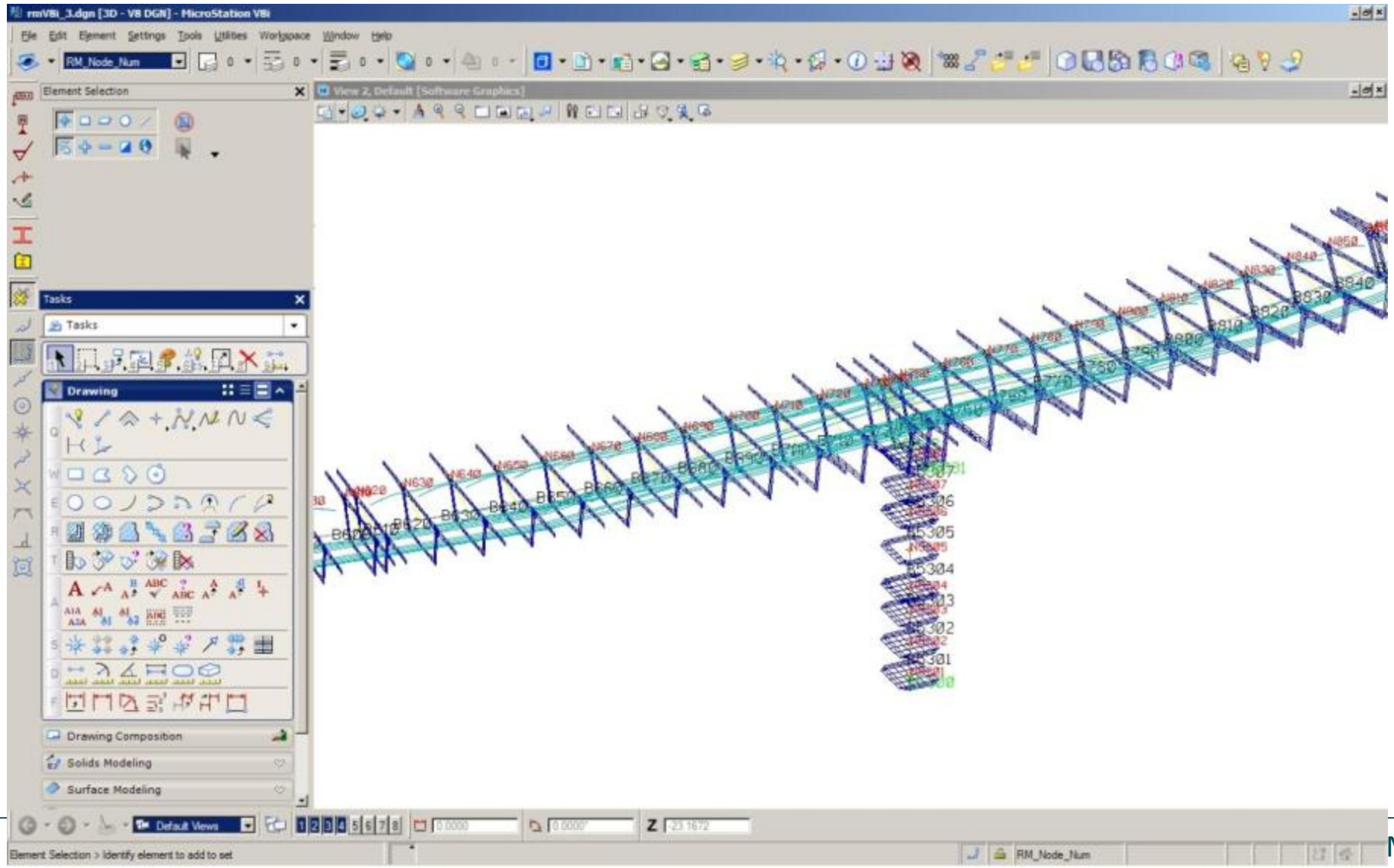
RM Bridge Model



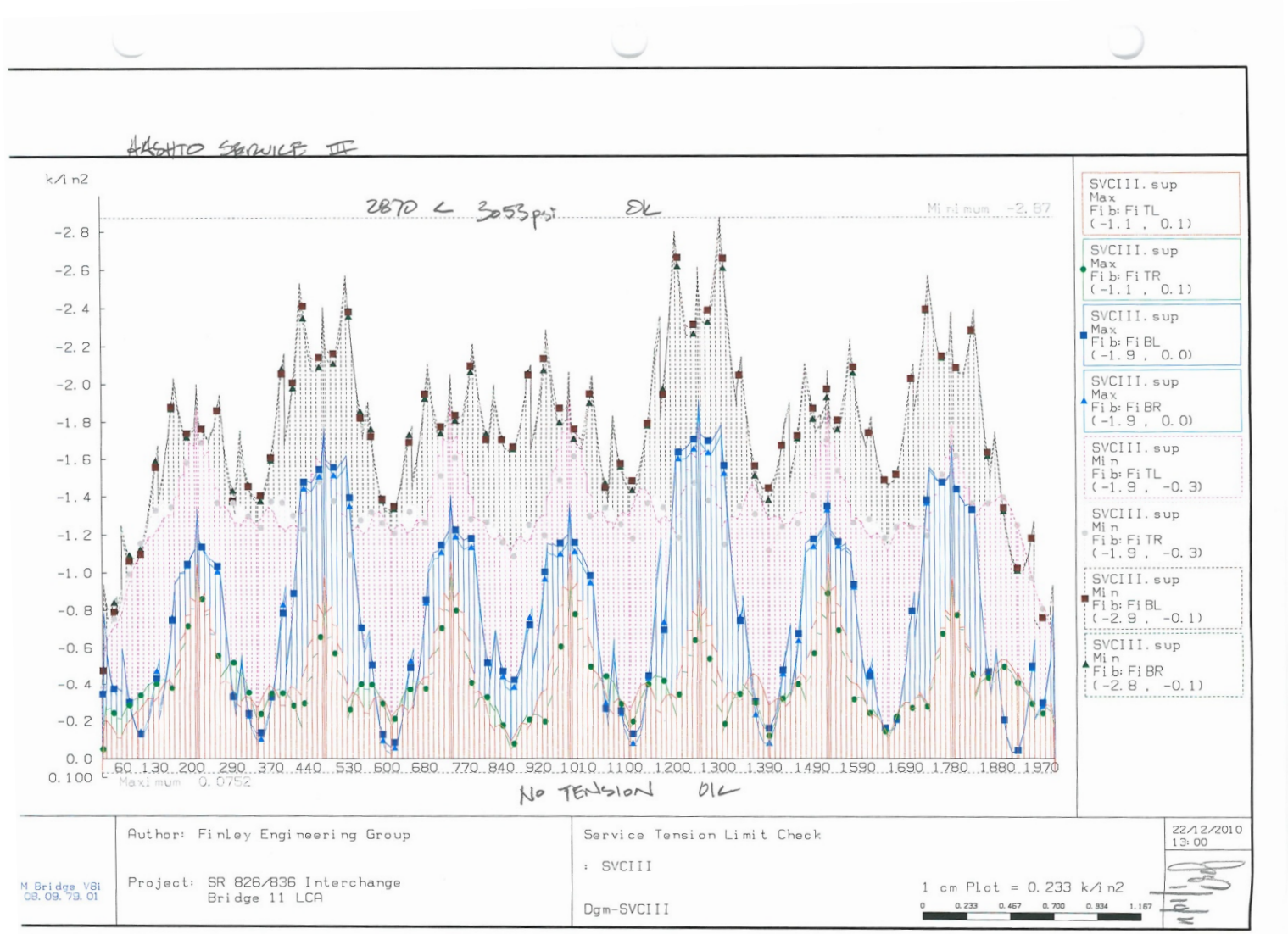
Design Approach



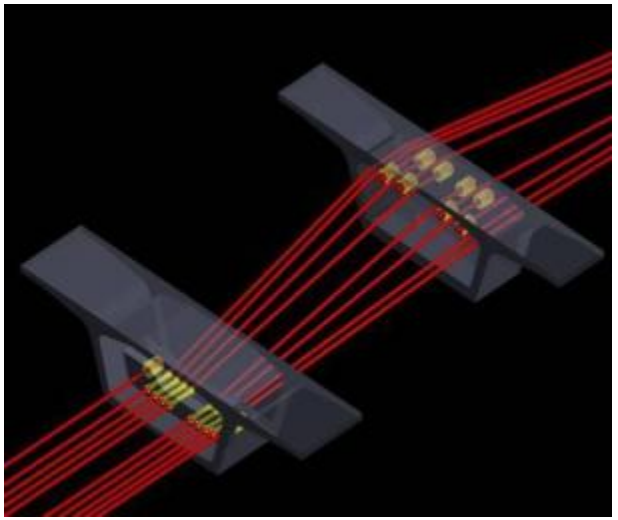
Design Approach



Design Approach



Special Details



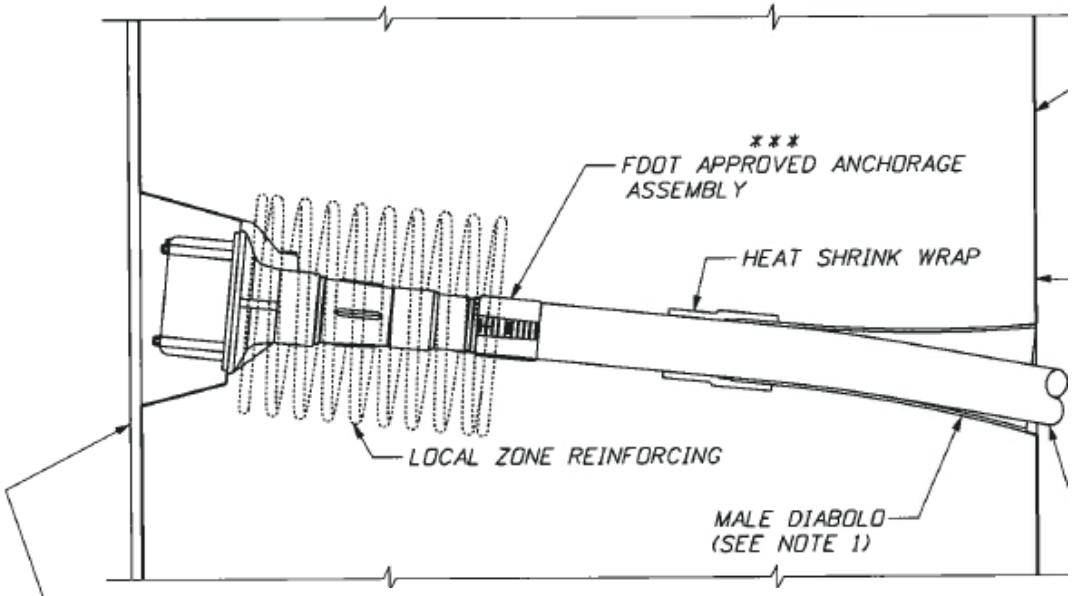
- Internal Cantilever PT Blister
- Anchorage & Diaphragm
- Diabolos
- Pier Segment Drop Beams
- Temporary Pier Tie Downs
- Minimized Expansion Joints

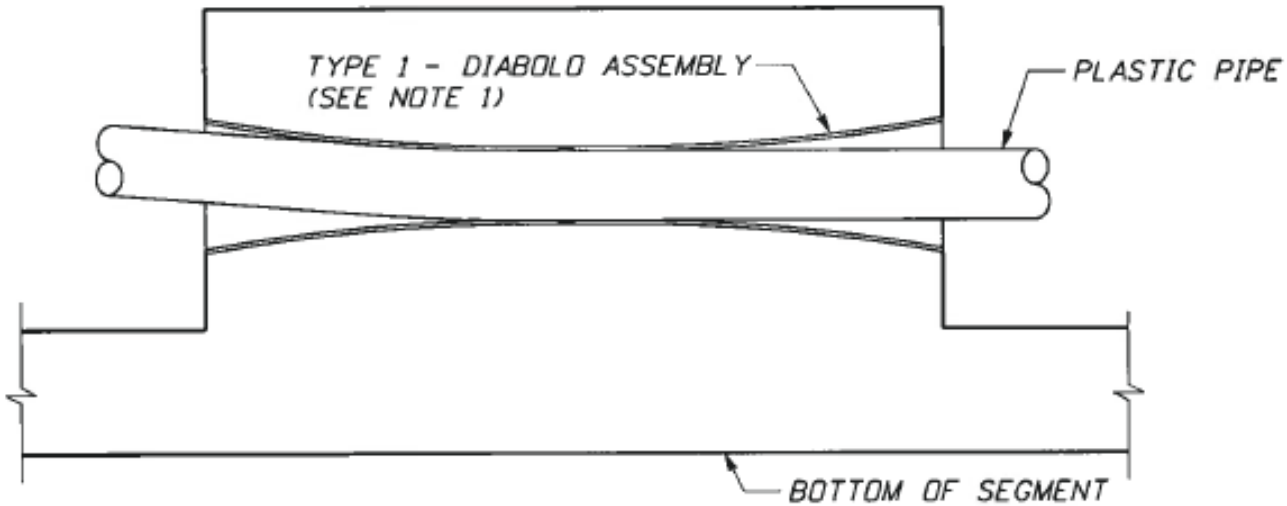
Diabolos

Diabolos

- **<u>First use of Diabolos in Florida</u>**:
  - Permitted as an ATC under a project specific Modified Special Provision
  - Limited to 10ft radius within diabolo
  - Allow tendon variable tendon geometry and continuous external tendon duct
  - Required testing of wear resistance and creep for approval

Diabolos





DEVIATOR SEGMENT

Diabolo Test Result

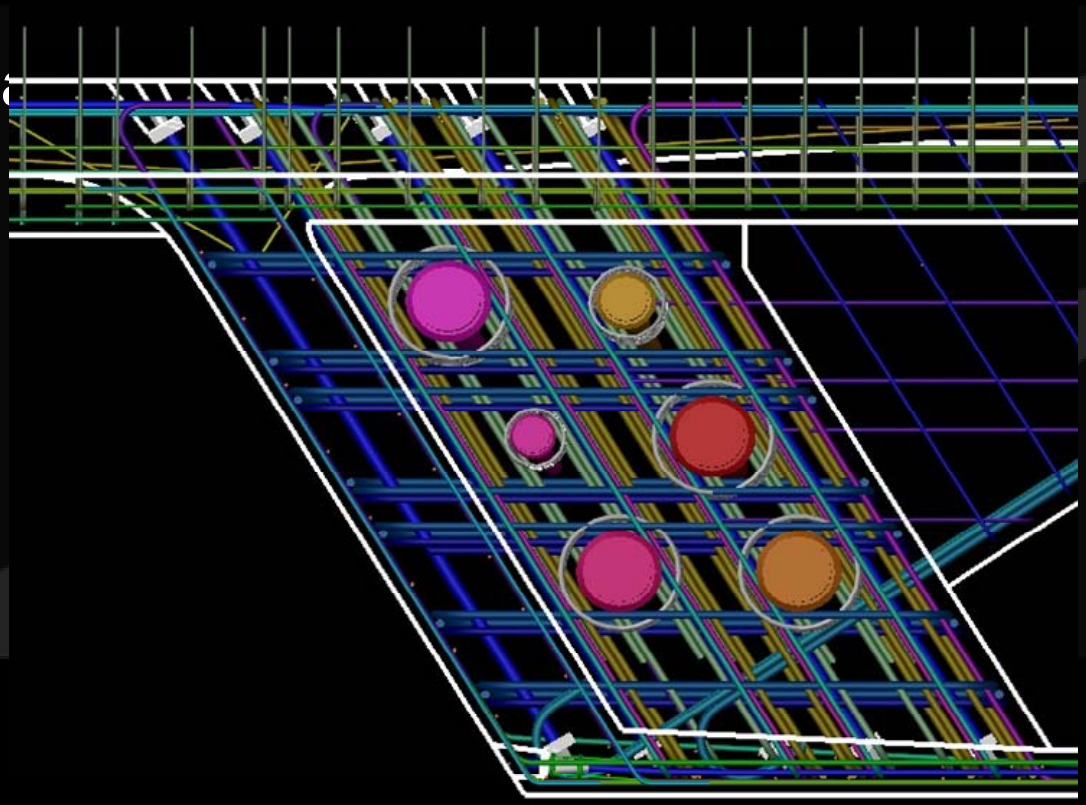
Construction Engineering

- **FINLEY services provided**:
  - Integrated segment drawings
  - Construction analysis
  - Temporary Works
  - Geometry Control
  - Technical Support

Integrated Shop Drawings

End View from 3-D Drawing

- S



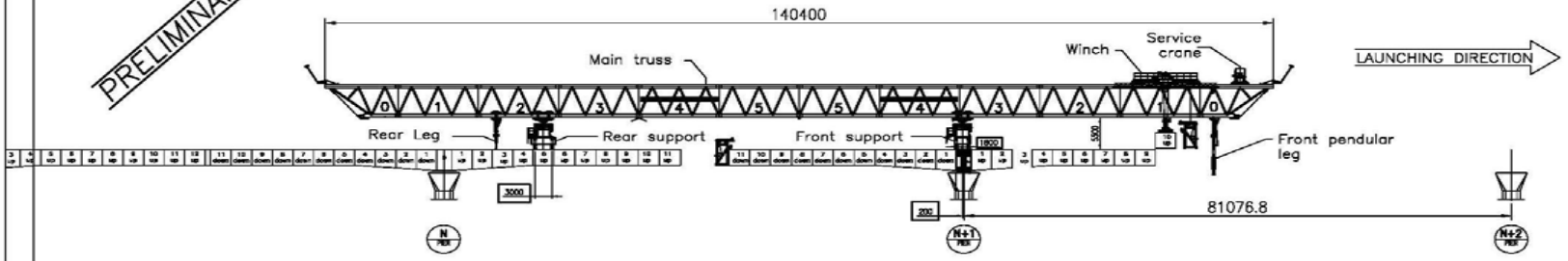
Anchorage Zone Reinforcement

Pier Segment Reinforcing Cage

Launching Truss

PRELIMINARY

CANTILEVER CONSTRUCTION – SAMPLE CONFIGURATION



DEAD LOADS

MAIN TRUSS + HEADS	2580 kN
REAR LEG	160 kN
REAR SUPPORTS (B)	450 kN
FRONT SUPPORT (C)	440 kN
FRONT PENDULAR LEG	150 kN
WINCH + MANIPULATOR	275+65= 340 kN
SERVICE CRANE	27 kN
STRESSING PLATFORM	2x49= 98 kN
TOTAL	4245 kN

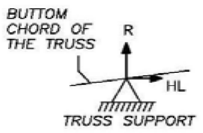
SEGMENT WEIGHTS

SEGMENT n°	P	1D/1U	2D/2U	3D/3U	4D/4U	TYP	DEV	EJ
WEIGHT kN	800	660	630	600	570	580	710	800

TRASVERSAL LOADS DUE TO WIND IN WORKING CONDITIONS

The following loads refer to wind speed of 20 m/s (72 km/h) – 250 N/m^2 and wind direction perpendicular to the main truss

MAIN TRUSS+HEADS	190 kN
WINCH + MANIPULATOR	5 kN
SERVICE CRANE	2 kN
AUXILIARY LEG	6 kN
REAR + FRONT SUPPORTS	2 x 6 = 12 kN
FRONT LEG	8 kN
SEGMENT	5 kN
TOTAL WIND LOADS	HTTOT = 228 kN



LONGITUDINAL LOADS DUE TO WIND AND SLOPE

On anchored support: HL= 0.5xHTTOT + vertical reaction R on free support x (p+m)%
On free support: HL= vertical reaction R on free support x (p+m)%
where p = longitudinal slope % (max 5%), m = friction factor (1%)

Revision	Date

DEAL

REFERENCE: LAUNCHING GIRDER L66
SCALE: /
DATE: 28/09/10
FILE:
DRW.: DT
TITLE: EQUIPMENT DATASHEET
DRAWING: L66DUDDO 001 REV 0 sheet 1 of 2

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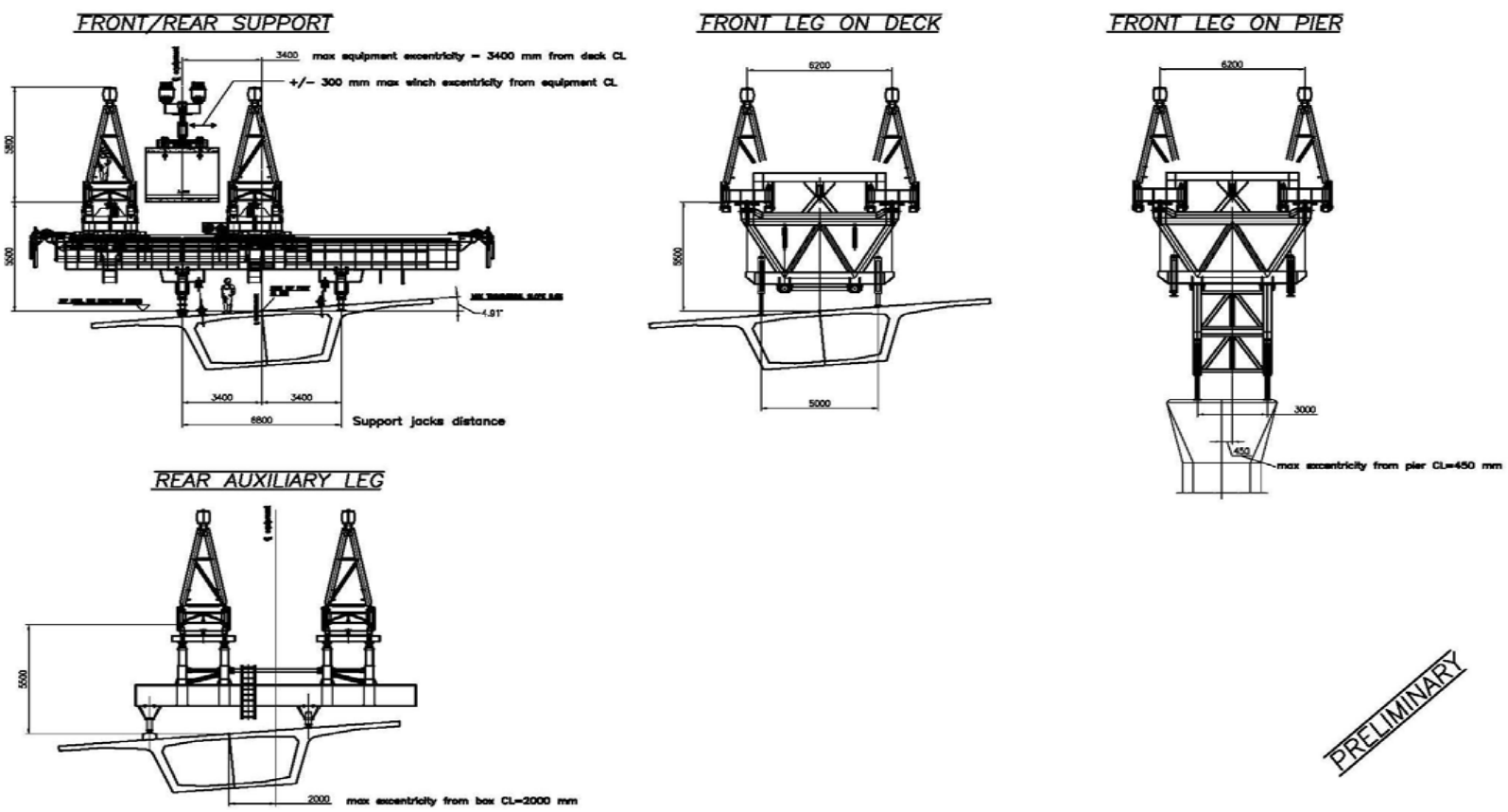
Launching Truss



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SCALE: /

DATE: 28/09/10

FILE:

DRW.: DT

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Similar Equipment

RIZZANI DE ECCHER

Similar Equipment

RIZZANI DE ECCHER

Similar Equipment

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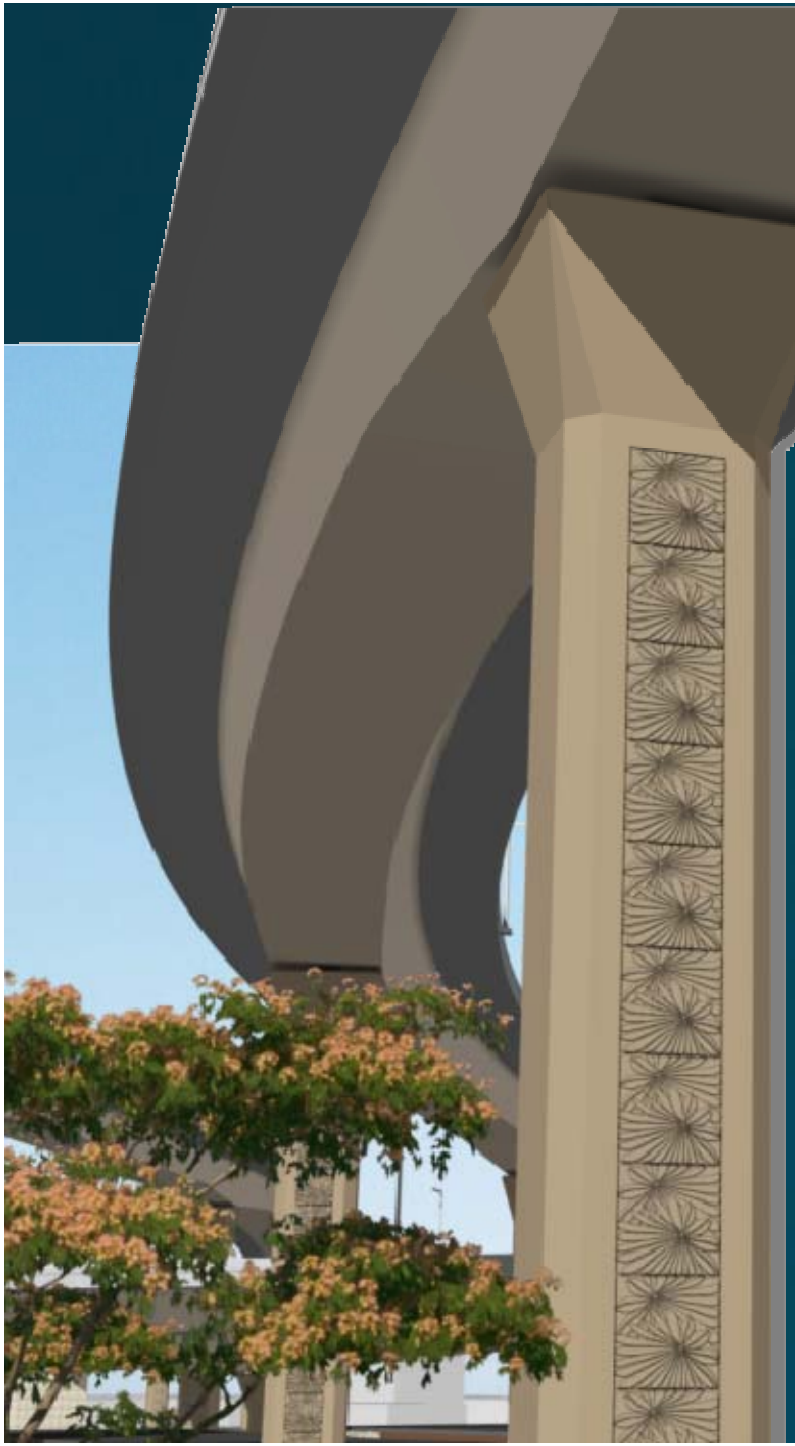

Questions and Answers

Bridging Challenges With Solutions®

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